California Regional Water Quality Control Board
North Coast Region

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TO:	Region 1 Dairy Work Group
FROM:	Dennis L. Salisbury
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SUBJECT:	RECOMMENDED BEST MANAGEMENT PRACTICES FOR DAIRIES AND OTHER ANIMAL FACILITY OPERATIONS IN REGION 1

The evaluation of a dairy or other animal facility operations for compliance with water quality regulations requires an in-depth understanding and analysis of not only the physical components, such as manure waste ponds, but also the management of those components. Described below are recommended best management practices (BMPs) for dairy and other animal facility operations in Region 1. Several individual control strategies for manure management are identified for each BMP. Reliance on a single practice is not likely to result in satisfactory control of manure and potential pollution. Many dairies and other animal facility operations in the North Coast Region have implemented these BMPs, with implementation dependent on site-specific conditions. The BMPs and control strategies have been ordered to generally reflect cost-effectiveness and applicability to dairies and other animal facility operations located in Region 1.

1. **SEPARATE CLEAN AND CONTAMINATED WATER.** Rainfall runoff should not come in contact with contaminated water from manured areas or washdown operations.
   - Divert clean runoff water from pastures and clean areas from corrals and holding pens.
   - Divert roof runoff from manured areas by guttering and diversions.
   - Minimize manured area runoff by adjusting confinement area fences.
   - Minimize manured area runoff by roofing areas with high manure concentrations.

Methods for implementing these control strategies include providing roof gutters on existing facilities, altering fencing in confinement areas, and construction of water diversion ditches. Roofing and animal housing is relatively expensive when compared to the cost of developing additional storage but there are animal health and production benefits.

2. **IMPROVE WASTE LIQUIDS COLLECTION AND STORAGE.** Waste liquids, including manure, wash water, and surface runoff from manured areas, must by law be diverted to retention ponds and effectively contained for later removal. Adequate storage pond size to contain the expected runoff from the wettest winter expected in 25 years as well

as the one-day runoff from a 25-year storm is recommended. This amounts to between three and four acre-feet of water for each acre of manured area.

- Size retention ponds to meet current and planned storage needs.
- Size retention ponds to provide minimum of two feet freeboard for design capacity.
- Collect runoff from corrals, holding areas, milking parlor, and other manured areas.
- Contain liquids around remote feed racks, whey stations, water troughs, and other manured animal concentration areas.
- Maintain pumps, equipment, and pipelines as required to manage liquid storage facilities.
- Provide storage ponds with appropriate pumping equipment and disposal areas to maintain minimum of two-foot freeboard during winter storm periods.
- Develop spill plan to show that emergency situations can be handled.

These control strategies can be implemented with construction of retention ponds, diversion channels, culverts, and gutters. Control and collection facilities are less expensive than large-scale roofing improvements.

3. **IMPROVE WASTE SOLIDS COLLECTION AND STORAGE.** Waste solids from confinement areas and remote locations should be contained and stored in a manner that will prevent contact with storm water runoff.

- Size storage pits for current and expected future needs.
- Scrape confinement areas before wet season and minimize use during winter.
- Maintain separator system if present.
- For separated manure and compost piles, provide storage facilities with satisfactory drainage controls.
- Minimize confinement areas (corrals, loafing areas, etc.) to the extent possible.
- Collect and store solids from remote locations (feed bunkers, water troughs, calf bedding, etc.) in storage pits.
- Collect and retain runoff water from solids pits and storage areas.

The consistent use of a tractor-loader-scraper is necessary to prevent solids from mixing with rainfall, washdown water, and other liquids. Solids accumulated in alleys and barns should be scarped daily to weekly, and solids from loafing areas scraped twice yearly. A separator is partially effective at isolating solids from liquids. Ponds receiving separated liquid will still require periodic cleanout of accumulated solids.

4. **PROVIDE EFFECTIVE WASTE LIQUIDS IRRIGATION AND DISPOSAL.** Liquid dairy waste should be irrigated properly to maximize fertilizer value and to minimize potential for causing non-point source pollution. Excessive irrigation may create direct runoff of liquid waste to waterways and increase the waste load potentially transported with stormwater runoff. Irrigation during the wet winter months is not recommended when the ground is already saturated and/or there is the likelihood of rainfall.

- Avoid use of pipe discharge systems as they create local over application resulting in poor pasture, weed problems, and potential for polluted runoff.
- Use custom operator or self-owned equipment on a timely basis for liquid disposal.
- Adjust application location and rate to meet crop and pasture demands. As a rule of thumb, between two and four inches of dairy wastewater may be applied annually per acre of good forage crop.
- Maintain disposal equipment properly.
- Have functional equipment available during winter for emergency irrigation disposal. (Winter irrigation should not be necessary if waste storage capacity is adequate, the ponds were emptied and cleaned before the winter season, and clean water diversions are properly maintained.)
- Clean retention ponds and dispose of excess liquids on an annual basis.

A wastewater irrigation system requires storage facilities, pumping equipment, main lines, and hand lines for placement of gun-type sprinklers. Labor is required to move lines, set pump times, monitor application rates, and maintain system components. Some high solids liquid manure will require large-clearance pumps, valves, and sprinkler nozzles to minimize plugging and associated maintenance requirements. For facilities using sand bedding, relatively high rates of pump wear and maintenance should be expected.

5. **PROVIDE EFFECTIVE SOLID WASTE APPLICATION AND DISPOSAL.** Apply manure, separated solids, bedding straw, compost, or other solid wastes properly to avoid excess that may lead to runoff problems or crop vigor degradation.

- Clean storage pits and dispose of solids on an annual basis.
- Use custom operator or self-owned equipment on a timely basis.
- Adjust application rate and location to meet crop and pasture demands.
- Maintain disposal equipment properly.
- Alternate disposal areas on an annual basis to maximize value of organic materials.

A truck with broadcast spreader and a loader tractor are necessary for effective management of significant volumes of solids. A contractor may be used for stockpiled solids disposal. The contractor typically uses multiple spreader trucks and loader for manure removal. For slurry manures, a mud cat, slurry pump and tank trucks are typically used.

6. **PROTECT AND ENHANCE EXISTING ENVIRONMENTAL RESOURCES.** Protecting and improving existing environmental resources can directly enhance surface water quality. Livestock should be prevented from accessing streams and runoff channels where wastes can be directly deposited in the waterway. Livestock traffic quickly erodes banks and stream bottoms, contributing more sediment to the waterway. Vegetated filter strips will help prevent excessive sediment from reaching waterways and may help with natural breakdown of dairy wastes. Filter strips are not very effective in limiting nutrient loading to receiving waters, so control of manure at the source is still important with these improvements. Armoring confinement areas will help minimize the amount of waste exposed to runoff. Constructed wetlands may have limited applicability in some situations for reducing sediment and nutrient loading to natural waterways.

- Exclude livestock from riparian areas and drainages.
- Develop and maintain riparian buffer zones.
- Construct and maintain filter strips between heavy use areas and runoff channels.
- Armor confinement areas to enhance manure collection and reduce erosion.
- Armor and provide for manure and runoff collection at remote feeding and watering areas.

Exclusionary fencing requires materials appropriate to the type of fence desired. Fencing costs are variable, from inexpensive and portable electric fences to substantial livestock control fences. Consider annual maintenance requirements, stock water, channel crossing, floodgates, trash loading, and similar effects when designing fencing. Consider livestock and equipment traffic patterns when installing fences. Consider developing enclosures suitable for short-duration dry season grazing management in order to retain economic productivity, control weeds, and maintain vigor of the plant community.

7. **ENHANCE PRODUCTIVITY OF EXISTING PASTURELANDS.** Improving the productivity of existing pasturelands will realize cost efficiencies, enhance livestock productivity, and minimize erosion and the amount of waste exposed to runoff.

- Fertilize under-performing pastures.

- Apply organic, liquid, or commercial fertilizers at rates appropriate for the crop. Liquid dairy waste can be applied to pastures at 2 to 4 inches per year depending on nutrient value. Solid dairy waste can be applied to pastures at 10 to 40 tons per acre per year depending on nutrient value.
- Interseed or reseed using clovers or other perennial native pasture grasses to enhance productivity and prevent erosion.
- Adjust animal stocking rates to match pasture conditions.
- Use appropriate cropping practices.
- Develop cross fencing for grazing management.
- Control introduced and invasive weeds (star thistle, broom, etc.) by mechanical and/or chemical means.
- Minimize non-productive barren ground sacrifice areas with livestock controls.
- Protect herd health and water quality by separating livestock from muddy, wet, and low areas.

Pasture improvement may be accomplished most easily and cheaply by an annual fertilizer program to enhance productivity of existing plants. Where necessary, additional desirable species may be developed by interseeding with no-till drill or broadcast and disking. Herd size and economics usually dictate stocking rates. Environmental and productivity concerns may be difficult to address. Weed control efforts should be in proportion to infestation level. Thistle control is most cost-effective if small populations are not allowed to establish seed reservoirs or get out of hand. Provide mechanical and/or chemical controls on an as-needed basis, ideally timed to prevent seed dispersal. Some low-quality grasses and weeds (e.g., foxtail and Italian thistle) may be voluntarily utilized as forage by range livestock if swathed and windrowed in the pasture when still green and prior to seed set.

8. **ENHANCE PRODUCTIVITY OF CROPLANDS.** Cropland in dairying regions is typically devoted to silage and/or hay production. In the Marin-Sonoma dairy belt, the major production styles include winter/spring single-crop dryland, and multiple-crop irrigated land using the tertiary quality wastewater from the Sub-regional (Santa Rosa) Domestic Waste Reclamation Facility. Use of liquid or solid dairy waste as crop fertilizer will complement use of commercial and wastewater fertilizers. The bulk nature of dairy waste limits the ability to cost effectively transport large distances, normally restricting use to on-farm or nearby areas.
   - Sampling of liquid and solid manure, soil, and forage for nutrient value prior to manure application is important when using multiple fertilizer inputs in order to adjust the nutrient application rate for maximum beneficial use.

- Apply organic, liquid, or commercial fertilizer at rates appropriate for crop.
- Consider fertigation of irrigated crops by blending reclaimed wastewater with other water.
- Fertigate during period of rapid crop growth to maximize benefits of applied materials.
- Fertigate at an annual rate equivalent to 2 to 4 inches manure water per acre depending on nutrient value.
- For dryland crop areas, follow practices and rate recommendations for pasture improvement practices.
- Apply manure to cropland just before tillage to maximize incorporation and minimize loss of nutrient due to volatilization or runoff.

For fertigation, appropriate liquid manure storage and use facilities are required. These include an injection pump station capable of variable injection rates of manure water into the existing irrigation system. Special equipment or hardware may be needed to handle manure solids or to operate with minimal wear or potential plugging. For dryland applications, manure is spread using normal undiluted liquid or solids disposal techniques described in previous BMP sections.

9. **MAXIMIZE BENEFIT/COST RATIO OF WASTE MANAGEMENT PRACTICES.** Appropriate waste management practices can maximize economic returns to the producer, while meeting pollution control guidelines. Appropriate manure application rates will minimize need for purchased fertilizer, and reduces the chance of promoting noxious weed growth. The organic component of agricultural manure helps build soil and provides nutrient benefits over a prolonged time period.

- Conduct soil or forage sampling prior to manure application for rate adjustment.
- Conduct sampling of manure solids or liquids for nutrient value prior to application to determine the appropriate nutrient application rate.
- Balance liquid application rate to crop or pasture needs.
- Use manure solids as a value-added product such as bedding or retail sale compost.

Management time is required for adjusting and monitoring application rates. Composting methods require labor, land, bulk handling equipment, and appropriate pollution controls. Much of the nutrient value of manure is lost during the composting process. Evaluation of large-scale composting effort should include return on investment and labor, and loss of crop or pasture production due to land requirements. Excellent publications are available from the University of California Cooperative Extension (UCCE) and other

sources for those considering composting or other alternative practices.

(R1 Dairy BMP Recommendations.doc)